

RESEARCH, DEVELOPMENT & TECHNOLOGY TRANSFER QUARTERLY PROGRESS REPORT

Wisconsin Department of Transportation
DT1241 02/2011

INSTRUCTIONS:

Research project investigators and/or project managers should complete a quarterly progress report (QPR) for each calendar quarter during which the projects are active.

WisDOT research program category: <input type="checkbox"/> Policy research <input type="checkbox"/> Other		<input checked="" type="checkbox"/> Wisconsin Highway Research Program <input type="checkbox"/> Pooled fund TPF#	Report period year: 2014 <input type="checkbox"/> Quarter 1 (Jan 1 – Mar 31) <input type="checkbox"/> Quarter 2 (Apr 1 – Jun 30) <input checked="" type="checkbox"/> Quarter 3 (Jul 1 – Sep 30) <input type="checkbox"/> Quarter 4 (Oct 1 – Dec 31)
Project title: Laboratory Study of Optimized Concrete Pavement Mixtures			
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WisDOT project ID: 0092-13-04		Other project ID: PRJ63JN	Project start date: 8/1/2012
Original end date: 1/31/2015		Current end date: 1/31/2015	Number of extensions: 0

Project schedule status:

☒ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Project budget status:

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
199185	21869	173649	87	90

Project description:

The Wisconsin Department of Transportation (WisDOT) continues to investigate the feasibility of optimization of paving mixtures as a means to improve the engineering properties, lower the required cementitious materials content, reduce cost, and minimize the environmental impacts. Previous research conducted by WisDOT concluded that concrete produced with reduced cementitious materials content had an adequate durability; however, these mixes frequently demonstrated poor workability. As a result, a multi-faceted approach to optimizing mixture proportioning for low-slump mixtures used in concrete pavements is needed for WisDOT to realize the benefits related to the use of lower cementitious materials contents. This approach includes the use of supplementary cementitious materials (SCMs), optimized aggregate gradations, and the use of superplasticizers (high-range water reducing, HRWR admixtures). Current WisDOT practice minimizes the use of portland cement through replacement with SCMs, but does not address the use optimized gradation or superplasticizers. Therefore, additional research is needed to support the development of specifications inclusive of the aforementioned factors to improve the performance and sustainability of concrete paving mixtures used in Wisconsin. This research project evaluates the feasibility of expanding current specifications to incorporate optimized superplasticized concrete in sustainable concrete paving applications.

The goal of this study is to produce guidelines for optimized concrete mix design by evaluating the performance of a range of concrete mixtures. The proposed performance evaluation of optimized concrete will include workability (slump and VB-test), air content, unit weight, compressive and flexural strength, freeze-thaw resistance, and rapid chloride permeability in accordance with relevant AASHTO/ASTM standards. The results of the research will be used to recommend the aggregate gradations and dosage of superplasticizers/HRWR admixtures that will accommodate the use of reduced cementitious materials for the low-slump concrete paving mixtures.

To provide the comprehensive optimization of superplasticized concrete, the proposed project will focus on the following objectives:

1. Develop a detailed, final testing matrix for comprehensive testing of aggregate gradations, SCMs and HRWR admixtures in concrete.
2. Evaluate and compare the composition, microstructural features, and physical properties of different types of cementitious materials essential for their compatibility with HRWR admixtures affecting their performance in concrete.
3. Evaluate the effect of HRWR admixtures on the fresh properties and mechanical performance of concrete.
4. Evaluate the effect of aggregate gradations on the fresh properties and mechanical performance of concrete.
5. Evaluate the effect of SCMs and HRWR admixtures on the stability of air void system, fresh properties, mechanical performance, and durability of concrete.
6. Develop and recommend for practical application an express-method capable of evaluating the performance of SCMs and HRWR admixtures in concrete.
7. Provide Life Cycle Analysis of sustainable optimized concrete paving applications based on the experimental results; submit a final report and recommendations for future work and revision of current specifications.

Progress this quarter

During the 3rd Quarter of 2014 all “big” concrete batches using Northern aggregates (106 liters each) were completed. The specimens were shipped to UW-Madison for rapid chloride permeability and freeze-thaw testing and the remaining specimens have been tested for compressive and flexural strength at 1, 3, 7, and 28 days; these concrete mixtures will be tested for compressive strength at 90 and 360 days. Initial length change measurements (up to the age of 28 days) have been performed and will continue to be performed for these mixtures. Durability testing related to the 1st stage of the project (optimization of Southern aggregates) was completed at UW-Madison. The durability test results are analyzed.

Anticipated work next quarter:

Durability tests using Northern aggregates including rapid chloride permeability and freeze-thaw testing are on the way to UW-Madison, however, these tests will be finalized only by mid-January. The 360-day compressive strength data will be available by the mid-July, 2015.

The empirical relationships between the results of mortar express-tests and concrete properties will be further explored.

The research team will provide the statistical analysis of experimental data; develop the relationships between the experimental factors and compare these with AASHTO/WisDOT/ACI requirements.

Circumstances affecting project or budget: None

Attach / insert Gantt chart and other project documentation Enclosed

FOR WISDOT USE ONLY

Staff receiving QPR: J. Walejko	Date received: 10/14/2014
Staff approving QPR: Andrea Breen	Date approved: 10/28/2014

Gantt Chart / Work Time Schedule

